地理学报(英文版) 2003年第13卷第3期

Statistic forecast of typhoons going over the Chinese coasts

作者: FENG Lihua WU Zhanghua

According to the measured data of typhoons going over the Chinese coasts in 1949-2002, a statistic relative equation showing the relation between the central atmospheric pressure of typhoons in a certain region at a certain period of time and their accumulation of frequency is established, and the concept of recurrence interval of typhoons is put forward, which is of actual significance for typhoon disaster reduction along the coastal area.

Statistic forecast of typhoons going over the Chinese coasts FENG Lihua, WU Zhanghua (Department of Geography, Zhejiang Normal University, Jinhua 321004, China) It is most populous with most developed economy and most concentrated social wealth along the coastal area of China. In fact the development along the coastal area gains both profit and restriction from the seas, for example, typhoon disaster is one of the biggest restrained factors. One typhoon, particularly typhoon over powerful tropical storm may make social and economic development along the coastal disaster affected area slip back two or three years, go so far as to seven or eight years. Therefore forecast and analysis of future landing typhoon along the coastal area is of actual significance for the national economy and the people´s livelihood. However, few researches have focused on this aspect and even much fewer results are of actual application (Feng, 2000). For this reason, the concept of recurrence interval of typhoon is put forward, and the statistic law of frequency and intensity of future landing typhoon is researched in accordance with the measured data of typhoons going over the Chinese coasts in 1949-2002. 1 The relation between the intensity of typhoons going over the Chinese coasts and their accumulation of frequency The strongest wind, speed, and central atmospheric pressure are the three targets of the intensity of a typhoon going over land. As the precision of the central atmospheric pressure has been observed more accurately, this paper takes the central pressure to show the strength of typhoon going over land. Table 1 shows the statistical data (1949-1992) of the central pressure of typhoons going over the Chinese coasts and their frequency (Meteorological Bureau of China, 1984-2003). This table shows that the lower the central pressure of typhoons goes, the less their frequency is; on the contrary, the higher the central pressure of typhoons goes, the more their frequency is. In order to find the statistic laws between the central pressure P of typhoons and their frequency m, the frequency m of typhoons of the central pressure P < Pi in a period of N years is accumulated (Table 1) and shown as accumulation of frequency M. Then, put P and M in a semi-logarithmic coordinate system (Figure 1). In Figure 1, P and M are distributed in straight-line. From this, it appears in the semi-logarithmic coordinate system a straight-line relation between central pressure of typhoons P and their accumulation of frequency M in a certain period of time N. That is lgM = aP + b. For the solution of this straight-line equation, the coefficients a and b in the equation may be determined by the least square method. To the typhoons going over the Chinese coasts from 1949 to 1992, a = 0.0309, and b = -28.12. Therefore Lg M = 0.0309P - 28.12 (1) Meanwhile, the relative coefficient R between P and M is R = 0.997. It is easy to see there is a close relation between the two. So as to examine the correctness of formula (1), similar straight-line distribution can be attained when the central pressure P of typhoons and their accumulation of frequency M with different periods of time N (25 and 50 years) in each region (China and Guangdong) are put in a semi-logarithmic coordinate system (Table 2). It is easy to see there is a close relation between them, too. 2 The statistical forecast of frequency of typhoons going over the Chinese coasts Formula (1) may be written as M = 100.0309P-28.12 (2) If formula (2) is divided by the statistic period of time-44 years, then the average frequency Mc with the central pressure P < Pi of typhoons in each year is M = = ×10 (3) then the average frequency Mt with the central pressure P < Pi of typhoons in t years is obtained as M = tMc = ×10 (4) Since formula (4) is a statistic relative formula bas

ed on the basic data of typhoons, so it can be adopted to forecast the frequency of typhoons with the central pressur e P < Pi in a period of t years. By means of formula (4), Table 3 is formed to forecast the frequency of typhoons wit h the central pressure P < Pi in one year (1993), in three years (1993-1995), and in six years (1993-1998). So far a s the coming three years are concerned, the calculated frequency of typhoons with central pressure P < Pi hPa is 4.8 5 times, and the actual frequency of typhoons with central pressure P < Pi hPa is five times. Table 3 shows that the calculated frequency of typhoons is nearly similar to its actual occurrence of time. Moreover, the longer the period of years is calculated, the smaller the error between the calculated figure and the actual frequency of typhoons is. 3 The recurrence interval of typhoons going over the Chinese coasts From the above discussion, Mt indicates the avera ge frequency of typhoons with the central pressure P ＜ Pi in t years. Put Mt = 1, then formula (4) may be written a s t = 44 ×1028.12 -0.0309P (5) This formula means the time it should take for the occurrence of a typhoon with the c entral pressure P < Pi, or the recurrence interval of a typhoon. Now, put T taking the place of t here to indicate "h appening once in several years". For example, if T = 8 years, it means a typhoon with central pressure P < Pi in ever y 8 years. However, the recurrence interval is an average number which means the sort of typhoon appeared on average but not exactly every 8 years in a pretty long period of time. Table 4 shows the calculated recurrence intervals of t yphoons and their actual ones with central pressure P < Pi going over the Chinese coasts from 1949-1992, in which th e actual recurrence interval Ts = 44/M (Table 1 for M). The average error between the calculated recurrence interval s and their actual ones has only 0.12 years, and the maximum error has only 0.35 years (Table 4). It makes clear tha t the calculated recurrence intervals are in line with the actual recurrence ones. 4 The statistical forecast of the intensity of typhoons going over the Chinese coasts If formula (5) is put into another form: P = (6) where P means th e central pressure (P < Pi) of a possible typhoon in a coming period of T years. Therefore, the central pressure (P < Pi) of a possible typhoon in a period of T years can be calculated by formula (6), by which Table 5 is made to fore cast the central pressure (P < Pi) of a typhoon occurring in one year (1993), three years (1993-1995), six years (199 3-1998) and 10 years (1993-2002). So far as the central pressure of a typhoon occurring in six years is concerned, th e calculated central pressure P < 938.07 hPa and the actual central pressure P = 935 hPa (No.9615 typhoon) in 1993-19 98; as well as that of a typhoon occurring in 10 years is concerned, the calculated central pressure P < 930.86 hPa a nd the actual central pressure P = 930 hPa (No.0010 typhoon, Bilis) in 1993-2002, both the cases correspond with actu al conditions. Table 5 indicates that the actual central pressures are all in accord with the calculated central pres sures in different years of forecast. Therefore the forecast is correct. 5 Conclusions From previous analysis some co nclusions are attained as follows: (1) It appears in a semi-logarithmic paper a straight line relation between centra l pressure P of typhoons and their accumulation of frequency M in an area in a certain period of time N, that is: lg M = aP + b. (2) The frequency of typhoons with central pressure P < Pi in a coming period of t years can be calculate d with formula (4). (3) The recurrence interval T of typhoons indicates the necessary period of time for the recurren ce of a typhoon with central pressure P < Pi. T means the recurrence interval for "every several years". (4) Formula (6) can be used to calculate central pressure (P < Pi) of a typhoon occurring in t years. As a natural and disastrou s phenomenon, the recurrence of typhoons is not avoidable. However, people can make efforts to realize the laws of re currence of typhoons. Of course, the recurrence interval and its calculated formula put forward express the average c onditions of typhoon activity in a future period, and they may be taken for a background datum. The investigation of the recurrence interval and statistical law of typhoon will deepen our understanding of the activity trend of typhoo n, which is favorable to establish the design standard of typhoon prevention in the engineering construction and to f inally reach the goal of typhoon control and disaster reduction.

关键词： typhoon going over land; central atmospheric pressure; statistical law; recurrence interval